2.0 PROPOSED ACTION AND ALTERNATIVES

2.1 BACKGROUND

The NEPA of 1969 and the Council on Environmental Quality (CEQ) regulations implementing NEPA require that the environmental impacts of any proposed Federal action be evaluated and considered in comparison to the impacts of various alternative actions. Alternatives available to DOE include (1) No Action, (2) construction and operation of these actions at other locations at Jefferson Lab, and (3) construction and operation of these actions at a location other than Jefferson Lab.

The proposed action evaluated herein will require additional DOE funding for upgrading the accelerators and for construction of buildings, including those associated with the CEBAF upgrade, and the construction of retention ponds and roads.[1]

The following sections present a description of the proposed action and alternatives and a comparison of the impacts of each. Note that the proposed action incorporates all related activities identified when this proposal was initiated.

2.2 DESCRIPTION OF THE PROPOSED ACTION

The proposed action in this EA (DOE/EA-1534) involves increasing the beam energy range of the CEBAF accelerator from the current maximum energy of 8.0 GeV at 1 MW to 16.0 GeV and increasing the beam power at CEBAF to 2 MW; expanding the North and South Access Buildings (#38 and #67) and Service Building (#98); and, upgrading the FEL to provide 190 kW light beam power. Also covered are the construction of a second CHL facility that would be connected to the current CHL; the construction and use of a new experimental area, the Hall D complex; excavation/construction of two retention ponds and associated surface water channels; construction of Technical Support Building #2 (TSB2); construction of a radioactive waste storage structure and several general site storage structures; expansion of Accelerator Site utilities including the construction of a 10 MW generator and pad; and constructing the North Connector Road extension and parking lot.[1] A vicinity plan of Jefferson Lab is provided as Figure 1. Figure 2 is a site map and includes the projects proposed in this EA. An aerial photograph of the site is provided as Figure 3. Figure 4 provides a rendering of the new Hall D experimental area.

2.2.1 Accelerator Upgrades and Related Actions

2.2.1.1 CEBAF and Experiment Area Upgrade and the Hall D Complex

The proposed action involves a change in the operating parameters of CEBAF that would require modifications to the accelerator housed in the underground enclosure, its support equipment contained in multiple above ground service buildings, and the Accelerator Site utility systems. The upgrade will enable Jefferson Lab to make important qualitative changes to its physics research capability at both the new Hall D and at the existing experimental area (Halls A, B, and C).

The Hall D complex will consist of an experimental hall, a counting house, beam dumps, cryogenics plant, and service buildings. The scientific goal of Hall D is to map the spectrum of gluonic excitations starting with exotic hybrid mesons. This upgrade will allow experimenters (users) to cross the threshold above which the origins of quark confinement can be investigated.

The continuous wave (CW) nature of the upgraded CEBAF beams will afford experimenters the opportunity to cleanly assess hadron structure throughout the entire "Valence Quark Region" and exploit newly discovered Generalized Parton Distributions. The upgrade will also allow direct exploration of the quark-gluon structure of hadrons and nuclei.

The upgrade to the 16.0 GeV range will allow Halls A and C to perform precise determinations of valence quark properties in nucleons and nuclei and to study short range correlations, form factors, and hypernuclear physics.

Hall B operations will be enhanced with new instrumentation (CLAS 12) which will be used to gain a new understanding of nucleon structure via measurements of generalized parton distribution.

The proposed changes in the maximum effective operating parameters of the CEBAF are presented in Table 1.

Table 1- CEBAF Maximum Effective Operating Parameters

Parameter	Present Operating Level	Proposed Operating Level at CEBAF	Proposed Operating Level at Halls A and C	Proposed Operating Level at Hall B	Proposed Operating Level at Hall D
Beam power	1000 kW (1 MW)	2000 kW (2 MW)	1 MW	27.5 kW	80 kW
Beam energy	8.0 GeV	16 GeV	16 GeV	16 GeV	16 GeV

2.2.1.1.1 No Action

Maintaining the status quo and not performing the upgrade means that the U.S. Nuclear Physics program will lose its world leadership in the study of hadronic matter. Significant investment has been made in the present facility that has already taken into account plans to incorporate a cost-effective upgrade into our current machine that would

provide scientific forefront capabilities and maintain this scientific leadership for the next decade and beyond. Not taking this opportunity would mean preventing the physics community from taking advantage of this scientifically productive machine. Not constructing the Hall D complex would result in the scientifically costly loss of one of the two major physics programs related to the Jefferson Lab upgrade, identified by the DOE Science Review in April 2005 as having discovery potential.

2.2.1.2 Alternatives Dismissed from Consideration

2.2.1.2.1 Construction and Operation of this Action at Another Location at Jefferson Lab

The proposed CEBAF upgrade utilizes the existing tunnel and does not change the existing basic layout of the accelerator. The planning for the CEBAF upgrade has optimized the equipment and buildings that would best serve the Lab and the taxpayers. The upgrade of the entire machine at a different location would require the duplication of many existing facilities to support this action and an increased environmental impact. This option would cost a considerable amount over and above what it would cost to upgrade CEBAF at its present location. The minimum required energy of 12.0 GeV can be achieved most economically by using the existing accelerator and by placing Hall D at the proposed location. Any other locations at Jefferson Lab would impact the technical capabilities of Hall D.

2.2.1.2.2 Construction and Operation of this Action at a Location Other than Jefferson Lab

Neither the DOE, nor the world, has an existing research accelerator that could be as easily modified to perform at the operating levels proposed by this action. CEBAF is the only high-average-current (200 microampere) continuous electron beam accelerator that can be used for conducting experiments in the 8.0 to 16.0 GeV range. It has the unique capability of providing a continuous beam as well as a pulsed beam. This feature enables it to better support nuclear physics studies because data is generated over a thousand times faster than at other pulsed-beamed accelerators. Therefore, the use of an accelerator at another DOE site for the research to be conducted at a beam energy of up to 16.0 GeV is not a reasonable alternative.

2.2.2 FEL Upgrade

The proposed action involves a change in the operating parameters of the FEL that would require modification to the accelerator and its support system. The upgrade will enable Jefferson Lab to make important qualitative changes to expand the capability of photonics research.

The CW nature of the upgraded FEL beams will permit, for the first time, propagation tests of any FEL to determine atmospheric response at significant power absorption within the desired wavelength bands while maintaining the short pulses characteristic of typical FEL output.

2.2.2.1 No Action

Maintaining the status quo and not performing the upgrade means that the U.S. Navy Directed Energy effort will be unable to determine the viability of free-electron lasers as defensive systems. Significant investment has been made in the present facility to develop this capability

at Jefferson Lab to bring this system to its forefront capabilities and provide photons for applied and basic research to establish a foundation on which to build this new capability.

2.2.2.2 Alternatives Dismissed from Consideration

2.2.2.2.1 Construction and Operation of this Action at Another Location at Jefferson Lab

The FEL is already constructed and can not be duplicated at another location at Jefferson Lab without considerable amounts of money over and above what it would cost to upgrade the FEL at its present location. Both the existing building and much of its support infrastructure have been designed to accommodate this power increase.

2.2.2.2.2 Construction and Operation of this Action at a Location Other than Jefferson Lab

Neither DOE, nor the world, has another existing research accelerator that could be modified to perform at the operating levels proposed by this action. The Jefferson Lab IR/UV upgrade FEL is the only high-average-current (10 milliampere) continuous electron beam accelerator that can be used for conducting experiments in the near infrared (IR), visible or ultraviolet. It has the unique capability of providing a continuous beam train as well as a pulsed beam, and it uses energy recovery. This energy recovery feature enables the FEL to operate continuously at high beam powers at high beam production efficiency with low radiation production. Therefore, the use of an accelerator at another DOE site for the high average power FEL research to be conducted is not a feasible alternative.

2.2.3 Construction of a Second Central Helium Liquefier (CHL #2)

Upgrading CEBAF will increase the heat load on the cryogenic system. The proposed action is to double the cryogenics capacity to meet the increased heat load. The existing CHL Building will be expanded by approximately 4,800 square feet (SF) to house the additional refrigeration equipment for CHL #2, and additional exterior gas storage vessels will be installed.

2.2.3.1 No Action

No Action would eliminate the capability of the CEBAF upgrade. As stated above, the U.S. Nuclear Physics program would lose its world leadership in the study of hadronic matter.

2.2.3.2 Alternatives Dismissed for Consideration

2.2.3.2.1 Construction and Operation of this Action at Another Location at Jefferson Lab

Other locations for CHL #2 would require duplication of existing facilities and increase the distribution distance to the point of use and increase the disturbed land.

2.2.3.2.2 Construction and Operation of this Action at a Location Other than Jefferson Lab

The CHL expansion is to support the CEBAF GeV upgrade and if this facility was in another location, it would not be able to serve the Jefferson Lab physics program.

2.2.4 Accelerator Site Utility Upgrade

Standard Utility System Modifications and the Related Building Modifications: Standard utilities, power, communication, and water systems will need to be upgraded to support the new operating levels of CEBAF and the FEL. As well as covering the accelerator upgrades, these described utility system expansions include the additional resources needed to support the new CHL #2 and the Hall D complex.

2.2.4.1 Accelerator Equipment Cooling: Low Conductivity Water (LCW) and Industrial Cooling Water (ICW)

The capacity of the three CEBAF/FEL ICW cooling systems at Buildings 8 (CHL #1), 38, and 67, including the associated cooling towers and pumping systems, will be expanded. The construction for these units will disturb a total of about 5,000 SF of grassed and/or paved area. Fresh water use will be increased to meet the higher cooling needs resulting from the new operating levels at the accelerators.

The LCW supply and distribution system at Buildings 38 and 67 will provide cooling for five additional radio frequency (RF) zones at the North and South Linacs and at the Arc 10 magnets to support the upgraded CEBAF operations, as well as the new Hall D transport line. Additions of 1,800 SF each to Buildings 38 and 67 (disturbing about 2,500 SF of asphalt paved area) will house the new LCW equipment.

2.2.4.2 CEBAF Tunnel Air Conditioning

The air conditioning of the CEBAF arc tunnel environments will have to be enhanced to handle the upgraded accelerator-generated heat loads. The present air conditioning system will be optimized to handle the increased heat load and maintain acceptable conditions by augmenting it to provide more cooling capability, possibly through the use of a natural convection system. The construction will disturb a total of about 2,000 SF of grassed area adjacent to the current equipment next to the CEBAF service buildings.

2.2.4.3 Electrical

The accelerator area power grid is proposed to be expanded by adding seven new unit substations and connecting them to the existing system via duct banks. In addition to this effort, a 10 MW generator pad, approximately 100 feet (ft.) x 100 ft., will be constructed in a grassed and wooded area west of the existing 40 MW substation to maintain liquid helium during extended power outages. As well, about 5,000 SF of land in the vicinity of existing service Buildings 38, 67, 8, and 18 will be disturbed. A 300 SF addition to Building 98 will house additional power supplies and disturb about 900 SF of paved area. The existing 40 megavolt ampere (MVA) primary substation's switchgear will require an expansion to accommodate the new substations for CHL #2.

2.2.4.4 No Action

If the utility system expansions noted in Section 2.2.4 do not occur, the No Action would eliminate the capability of the CEBAF upgrade, including the production of the correct type of beam to do research at Hall D. CEBAF, the FEL, and their support equipment positioned around the Accelerator Site would continue operating using the current utility network.

2.2.4.5 Alternatives Dismissed from Consideration

2.2.4.5.1 Construction and Operation of this Action at Another Location at Jefferson Lab

If other Jefferson Lab locations for the utility upgrades were to be utilized, it would increase the distribution distance to the point of use. As such, there would be transfer inefficiencies that would adversely affect operations.

2.2.4.5.2 Construction and Operation of this Action at a Location Other than Jefferson Lab

Since these utility upgrades are in support of CEBAF and the FEL, it would not be feasible for them to be constructed and used at other locations away from the Jefferson Lab site.

2.2.5 East and West Retention Ponds and Associated Surface Water Channels

Jefferson Lab completed a site wide storm water management study in 2003 that was updated in 2004. The Accelerator Site area is split between two watershed areas. The ponds and associated storm water channels are proposed to manage the increased storm water runoff from planned construction.[1] The East Retention Pond will be located east of Building 63 in Watershed Area 1 and will disturb about five acres of grassed and wooded areas. The West Retention Pond will be located east of Building 72 in Watershed Area 2. The west pond will disturb approximately 1.5 acres of grassed and wooded areas.

2.2.5.1 No Action

Section 402 of the Clean Water Act established the National Pollutant Discharge Elimination System to limit pollutant discharges into streams, rivers, and bays. In the Commonwealth of Virginia, both the Department of Environmental Quality (DEQ) and the Department of Conservation and Recreation (DCR) administer the program as the Virginia Pollutant Discharge Elimination System (VPDES). DEQ and the DCR coordinate separate Commonwealth programs that regulate the management of pollutants carried by storm water runoff. DEQ regulates storm water discharges associated with "industrial activities," while DCR regulates storm water discharges from construction sites and from municipal separate storm sewer systems (MS4s). The proposed action is in accordance with Jefferson Lab's VPDES MS4 permit. Action is required to support the new development.[1]

If No Action were taken, the Lab would not be able to manage the increased storm water runoff leaving the site with future developments. These ponds address the new development document.[1]

2.2.5.2 Alternatives Dismissed from Consideration

2.2.5.2.1 Construction and Operation of this Action at Another Location at Jefferson Lab

Jefferson Lab's site wide storm water management study identified the proposed locations as the optimal sites to manage the increased storm water runoff due to increased impervious surfaces from new developments.[1] Therefore, siting the ponds in different locations on site, while remaining within the same drainage area, would not have the benefit of serving the drainage area affected most by this disturbance.

2.2.5.2.2 Construction and Operation of this Action at a Location Other than Jefferson Lab

Since the new developments are going to be performed at Jefferson Lab, siting retention ponds at a location other than Jefferson Lab was not considered.

2.2.6 Technical Support Building 2

This project will provide for the construction of a new two-story, 16,000 SF technical support facility for operations on the Accelerator Site. The proposed site is at the northwest corner of the Accelerator Site and will take up about half of an existing bulk lay-down area. The facility will provide technical spaces, offices, and a high bay area for equipment assembly. This project will disturb about 1 to 1.5 acres of land, which includes parking for building occupants and a drive-through access to the high bay space. Utilities will be extended from adjacent utility distribution systems, so only a minor utility upgrade for this project is needed. The majority of the construction area is a gravel yard that is in use as an equipment storage area. A small amount of tree clearing may be necessary at the site perimeter, which will be determined as the facility layout is finalized. Storm channels in the vicinity may need to be modified or rerouted.

The presently stored materials and equipment will be relocated to other existing storage locations or inside the planned storage buildings described in 2.2.8, so no other area is to be disturbed for that action.

2.2.6.1 No Action

This project is to support current operations. Current staff and users are working out of aging trailers and out of accelerator service buildings not designed for occupants. As well, many of the involved groups are not collocated or are not located near their technical work area. Jefferson Lab has a large backlog of user experiments consisting of increasingly more complex setups, some taking up to six months to stage. No Action will continue use of sub-standard work spaces and operational inefficiencies.

2.2.6.2 Alternatives Dismissed from Consideration

2.2.6.2.1 Construction and Operation of this Action at Another Location at Jefferson Lab

As part of the Ten-Year Site Plan development, Jefferson Lab identified the need for two Technical Support Buildings to meet current technical, office, and experimental setup space. The two buildings are to be located at opposite ends of the Accelerator Site at concentrated work centers to maximize flexibility and minimize impact to non-developed land. The need and location for Technical Support Building #1 was identified in the 2002 EA.

2.2.6.2.2 Construction and Operation of this Action at a Location Other than Jefferson Lab

This project is to support current operations and to provide for a work area near the accelerator complex. Having it at a location other than Jefferson Lab will not improve interaction inefficiencies.

2.2.7 Low-Level Radioactive Waste Handling Storage Building

This project is for a low-level radioactive waste (RAD) storage building consisting of approximately 2,400 SF. The RAD storage space will provide an enclosed space to meet both existing and future needs as a staging area until the waste can be disposed of off site. A new limited access gravel road will be constructed from an existing paved roadway to serve the new building and the structures described in 2.2.8. A continuous apron along the front of the building will facilitate loading and unloading activities. The building will be placed on a concrete pad, with the perimeter pitched to allow water to drain away from the building. As utility service for this building is minimal, required utilities will be extended from an adjacent utility line, so no utility upgrade is anticipated. The project, including the access road up to this building and a limited gravel parking area, would disturb about 12,000 SF of grassed area within the Accelerator Site north of the North Linac building.

2.2.7.1 No Action

This project is to centralize the storage of the RAD waste on the Accelerator Site where the majority of the waste is generated. No Action will continue transport of RAD waste to various existing temporary storage facilities located around the Jefferson Lab site and continue the inefficient operations that result from having multiple storage areas.

2.2.7.2 Alternatives Dismissed from Consideration

2.2.7.2.1 Construction and Operation of this Action at Another Location at Jefferson Lab

This project will consolidate the present RAD storage areas at Jefferson Lab onto the Accelerator Site where the majority of the RAD waste is generated. Currently, the majority of the RAD waste is stored off the Accelerator Site. Other locations on the Accelerator Site would require more roadway development for access than what is needed for the selected location. As well, access to utilities would be less conveniently located than those to be accessed at the selected site.

2.2.7.2.2 Construction and Operation of this Action at a Location Other than Jefferson Lab

This project is to support day to day Jefferson Lab operations and will not meet the program needs if performed at a location other than Jefferson Lab.

2.2.8 General Site Storage Structures

This project, to take place in two separate areas, will provide for the construction of approximately 9,600 SF of new general storage space consisting of two complexes that will be 40 ft. x 60 ft. pre-manufactured buildings to house equipment and components. Both sites are on the Accelerator Site. The first is the existing bulk storage area located near Canon Boulevard and the second is located behind the North Linac Service Building, just west of the proposed RAD building. The first site, an existing gravel hardstand area, would not require any additional service roads but has sufficient area for only two of the four buildings. The second site would require a new access road constructed along the rear of the North Linac Service Building, an extension of the road noted in 2.2.7 that will connect to an existing paved road. A continuous apron will be constructed along the front of the buildings which will facilitate access for loading and unloading to each building. All four buildings will be placed on individual concrete pads

with the perimeters sloped to provide drainage away from the buildings. As utility service for these buildings is minimal, the required utilities will be extended from an adjacent utility line, with no utility upgrade anticipated for either site. Construction at the first site would affect about 12,000 SF of gravel surface. Construction of the project at the second site, including the local parking and the road extending from the RAD building, would disturb about 15,000 SF of grassed area.

2.2.8.1 No Action

Jefferson Lab currently has one onsite storage building and approximately 70 shipping containers that it uses for storage. Experimental equipment is typically shipped to the Lab by the research-sponsoring institution for assembly. The components are collected and stored where possible and then moved to an experimental setup area for assembly. As some of the stored items require protection from the weather, No Action would require the continued use of shipping containers and temporary coverings for storage of these materials.

2.2.8.2 Alternatives Dismissed from Consideration

2.2.8.2.1 Construction and Operation of this Action at Another Location at Jefferson Lab

Locations off of the Accelerator Site were reviewed and deemed to be too inconvenient to the locations where the materials would be of most use. As a better fit to meet site needs for convenient storage, various locations on the Accelerator Site were considered.[1] These other locations on the Accelerator Site would require construction of more access roadway than would be required for the consolidated layout that also involves the radioactive waste storage building.

2.2.8.2.2 Construction and Operation of this Action at a Location Other than Jefferson Lab

Offsite storage is not practical because of the size of the material (transport on public roads can be hard to manage) and it would prevent regular access to stored materials. This project is to support Jefferson Lab operations and will not meet the requirement at a location other than Jefferson Lab.

2.2.9 North Connector Road Extension

This project is to extend the North Connector Road (north of CEBAF Center) from Rutherford Road to Rattley Road. This would connect the west and east sides of the campus area and improve access throughout Jefferson Lab. The project would disturb about 20,000 SF of wooded area.

2.2.9.1 No Action

No Action would place Jefferson Lab at risk during heightened security levels, since Jefferson Lab has two points of controlled entry. This requires staff to exit one secure area and enter another secure area to move from the north end of the site to the south end. The two points of entry increases security costs and reduces productivity of staff that need to progress from one end of the site to the other. Also, future increased staff and users on existing roads will increase safety risks during peak traffic times.

2.2.9.2 Alternatives Dismissed from Consideration

2.2.9.2.1 Construction and Operation of this Action at Another Location at Jefferson Lab

Due to the current location of existing roads and parking lots, the other considered locations for a connecting road would not provide access to as many parking lots and site exit points.

2.2.9.2.2 Construction and Operation of this Action at a Location Other than Jefferson Lab

This project is to support Jefferson Lab operations and will not meet the requirement at a location other than Jefferson Lab.

2.2.10 North Connector Road Parking Lot

This project is to construct a parking lot north of the existing North Connector Road. The parking lot would be constructed over an existing geothermal well field that provides cooling to CEBAF Center. The project would disturb about 60,000 SF of grassed area.

2.2.10.1 No Action

No Action would continue the traffic safety risk on Rutherford Road and continued use of a grass field for parking during periods of high occupancy, such as during conferences that utilize CEBAF Center for meetings, at Jefferson Lab. Almost the full length of Rutherford Road has parking on both sides. This requires drivers to back out of parking spaces directly onto the road creating a safety hazard.

2.2.10.2 Alternatives Dismissed from Consideration

2.2.10.2.1 Construction and Operation of this Action at Another Location at Jefferson Lab

Construction of the parking lot at other locations at Jefferson Lab would require additional disturbance of grassed and/or wooded areas and other locations would not be centrally located to such a large proportion of Jefferson Lab staff and users that will have workspaces in the local area.

2.2.10.2.2 Construction and Operation of this Action at a Location Other than Jefferson Lab

This project is to support Jefferson Lab operations and will not meet the requirement at a location other than Jefferson Lab.